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Observations of a Unique Type of ULF Waves by Low-latitude Space Technology 5 Mission

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Abstract. We report a unique type of ULF waves observed by low-altitude Space Technology 5 (ST-5) constellation mission. ST-5 is a three micro-satellite constellation deployed into a 300 x 4500 km, dawn–dusk, and sun synchronous polar orbit with 105.6° inclination angle. Due to the Earth’s rotation and the dipole tilt effect, the spacecraft’s dawn-dusk orbit track can reach as low as subauroral latitudes during the course of a day. Whenever the spacecraft traverse across the dayside closed field line region at subauroral latitudes, they frequently observe strong transverse oscillations at 30-200 mHz, or in the Pc 2-3 frequency range. These Pc 2-3 waves appear as wave packets with durations in the order of 5-10 minutes. As the maximum separations of the ST-5 spacecraft are in the order of 10 minutes, the three ST-5 satellites often observe very similar wave packets, implying these wave oscillations occur in a localized region. The coordinated ground-based magnetic observations at the spacecraft footprints, however, do not see waves in the Pc 2-3 band; instead, the waves appear to be the common Pc 4-5 waves associated with field line resonances. We suggest that these unique Pc 2-3 waves seen by ST-5 are in fact the Doppler-shifted Pc 4-5 waves as a result of rapid traverse of the spacecraft across the resonant field lines azimuthally at low altitudes. The observations with the unique spacecraft dawn-disk orbits at proper altitudes and magnetic latitudes reveal the azimuthal characteristics of field-aligned resonances.

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